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REPORT TITLE: Beaufort Sea Petroleum Technology Assessment.

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SPONSORING OCS REGION: Alaska.

APPLICABLE PLANNING AREA(S): Diapir Field.

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PROJECT MANAGER(S): D. Padron.

AFFILIATION: Han-Padron Associates.

ADDRESS: 1270 Broadway, New York, New York 10001.

PRINCIPAL INVESTIGATOR(S)*: D. Padron.

KEY WORDS: Diapir Field; Beaufort Sea; development scenarios; technology assessments; ice; marine traffic; transportation; exploratory drilling.

BACKGROUND: The Diapir Field Lease Sale 97 (December 1986) area is located in the multiyear ice zone of the Beaufort Sea. Assessment of current petroleum technology (exploration, production, and transportation) is required for the Minerals Management Service to assess potential social, economic, and physical effects of petroleum development; prepare Environmental Impact Statements; and estimate area resource potential in the Diapir Field Planning Area.

OBJECTIVES: (1) To identify and evaluate various offshore petroleum development technologies in the multiyear ice zone of the Beaufort Sea; (2) To analyze onshore and offshore sand and gravel extraction and use for exploration and production platforms, causeways, etc.; and (3) To analyze unit costs, timing, and manpower for Beaufort Sea offshore petroleum development.

DESCRIPTION: The study area included a 20 to 90 m water depth range in the Diapir Field Planning Area. This area represents the area beyond current Beaufort Sea activity and within the range of existing exploration, production, and transportation technologies. Values for all relevant environmental parameters and forces exerted on offshore structures were determined from available information.

This report assessed current petroleum technology in the Beaufort Sea and analyzed potential unit costs, construction schedules, and manpower requirements for Diapir Field region planning. Topics presented in chapters included: potential environmental conditions and forces exerted on offshore structures; assumed petroleum production parameters; potential sources of onshore and offshore granular borrow material; construction techniques unique to offshore development in the Beaufort Sea; requirements and costs of exploration and production topsides equipment; drilling techniques and costs for exploration and development wells; ancillary vessel technology; manpower requirements and costs; and support facilities and base camp requirements and costs.

SIGNIFICANT CONCLUSIONS: Sea ice is the major environmental hazard to petroleum development facilities in the Beaufort Sea. Preliminary facility designs have been based on existing information on sea ice and other environmental criteria, but final designs must be based on site-specific data. Ice island interaction with bottom founded production platforms requires further study.
Exploration and production costs are sensitive to seabed conditions. Any offshore project will require site-specific geotechnical studies.

In water depths greater than 35 m prefabricated bottom founded structures are the most cost effective exploration platforms; in shallower water, caisson retained islands and sacrificial beach islands may be more cost effective, depending on location of suitable, accessible granular borrow material. Limited drilling season from ice conditions and regulatory constraints protecting whales make floating exploration platforms not cost effective. Prefabricated bottom founded structures are the most cost effective production platforms in deep water; in shallow water, caisson retained islands are cost effective if suitable granular borrow material exists adjacent to the site.

The Trans-Alaskan Pipeline System (TAPS) is the preferred crude oil transportation method. Class 8 icebreaker tankers are an alternate method.

STUDY RESULTS: Sea ice is the major environmental hazard for petroleum development facilities. Geological hazards include fine-grained soils, permafrost, natural gas hydrates, shallow gas deposits, seismicity, ice gouging, "strudel" scour, and coastal erosion.

Production from the study area will be primarily crude oil. Non-associated gas production will not be economically justified for 20 years.

Onshore and offshore sources of granular borrow material have been identified. Site-specific field and laboratory studies are required to confirm quality and quantity of resources.

Exploration and production platform concepts have been proposed for study area water depths. Absolute engineering constraints do not exist for development. Generalized exploration platform concepts for artificial island, bottom founded, and floating systems are developed to estimate platform and drilling costs. Requirements of production platforms to remain on station for long time periods and support oil/gas/water separation equipment cause high costs. Prefabricated bottom founded structures are the most cost effective exploration and production platforms in deep water (+35 m). Depending on accessibility of suitable granular fill source, caisson retained islands and sacrificial beach islands may be more cost effective as shallow water exploration platforms. However, sacrificial beach islands require high annual maintenance, making caisson retained islands more cost effective as production platforms.

The existing TAPS connected to marine and land pipelines is the primary alternative for crude oil transportation. Class 8 icebreaker tankers are cost effective if the TAPS is not available. A sensitivity case analysis and assessment is presented of technology, manpower requirements, and costs for alternate transportation systems including marine and land pipelines, offshore and nearshore loading terminals, and Arctic tankers.

STUDY PRODUCT(S): Han-Padron Associates. 1985. Beafort Sea Petroleum Technology Assessment. A final report for the U.S. Department of the Interior, Minerals Management Service Alaska OCS Region, Anchorage, AK. Social and Economic Studies Program Technical Report No. 112. Contract No. 14-12-0001-30154. 458 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).